D-1561

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Title of the Invention D-1561

ORIGINAL TRANSPORT APPARATUS, ORIGINAL TRANSPORT METHOD AND IMAGE READING APPARATUS

Background of the Invention and Related Art Statement

[0001] The present invention relates to an original transport apparatus mounted on a copier or facsimile device for transporting an original to a predetermined reading position to read an image thereupon, and an original transport method for transporting the original. More specifically, the present invention relates to an original transport apparatus and original transport method in which the originals are efficiently discharged without disrupting an order of the original pages after both sides of the originals are read consecutively.

[0002] When an image reading apparatus sequentially reads a plurality of originals automatically, the original are transported and read at a predetermined reading position in the image reading apparatus (sheet-through reading method).

[0003] In this method, the original stacked on an original tray is fed one at a time and read while being turned over (inverted) by 180□ degrees before being discharged on a discharge tray. Therefore, when only a single side of the original is read sequentially, the originals are discharged on the discharge tray with a page order same as that on the original tray.

[0004] When both sides of the original are read, after one side of the original is read, the original is turned over to read an image on the other side of the original. When the originals are discharged on the original tray, the originals are stacked in an order reversed from that on the original tray.

[0005] Japanese Patent Publication No. 2001-354336 has disclosed a conventional image reading apparatus for reading both sides of an original. In the apparatus, after one side (front side) of the original is read, the original is turned over to read an image on the other side (back side) of the original. After the reading, the original is turned over again. Then, the original is passed through a reading position without being read and discharged to a discharge tray, so that the originals are placed on the discharge tray in an order same as that on an original tray.

[0006] In the conventional reading apparatus disclosed in Japanese Patent Publication No. 2001-354336, for reading both sides of the original without reversing the page order, it is necessary to turn over the original again after the backside thereof is read, and then the original is turned over again. Then, the original is passed through the reading position without being read (non-scan feed) and discharged to the discharge tray. Accordingly, the original is passed through the reading position three times in order to read the original twice, i.e. both sides thereof, thereby making it difficult to read the original at a high speed.

[0007] In view of the problem described above, the present invention has been made, and the first object of the present invention is to provide an original transport apparatus and original transport method in which when both sides of originals are read, the originals are discharged in an original order without reversing the order of the originals being read, and the originals are read at a high speed.

[0008] The second object of the present invention is to provide an original transport apparatus and original transport

method in which both sides of the originals are read efficiently without passing the originals through a reading position only for organizing the page order as does the conventional apparatus.

[0009] Further objects and advantages of the invention will be apparent from the following description of the invention.

Summary of the Invention

[0010] To attain the aforementioned objects, according to the present invention, an original transport apparatus includes an original tray for stacking an original; feed means for feeding the original one at a time to a predetermined feeding position; transport means for transporting the original from the feeding position to a discharge outlet via a reading position; a switchback path disposed adjacent to the discharge outlet in a discharge direction for switching back and turning over the original; a re-feed path for guiding the original to the feeding position after the original is switched back and turned over in the switchback path; and discharge means disposed at a downstream side of the switchback path for discharging the original to a discharge tray after the original is read.

[0011] In the original transport apparatus and original transport method of the present invention, after both sides of the original are read, the original is fed to the feeding position via the switchback path. The feed means transports the original via the reading position while the original is overlapped with a next original to be read, and the discharge means discharges the first original via the discharge outlet.

[0012] In the invention, after reading the original, the original is overlapped with the next original and is fed to organize a page order. Accordingly, it is possible to transport

the original and the next original at the same time. As a result, it is possible to read both sides of the original and obtain the original page order. In the conventional apparatus, it is necessary to transport the original three times through the reading position for reading both sides of the original and organizing the page order. In the invention, it is possible to complete the reading by transporting the original twice, thereby reading both sides of the original at a high speed. An image reading apparatus provided with the original transport apparatus described above achieves the same effects.

Brief Description of the Drawings

[0013] FIG. 1 is a sectional view of an original transport apparatus mounted on an image reading apparatus according to the present invention;

FIG. 2 is an enlarged view of the original transport apparatus shown in FIG. 1;

FIG. 3 is a view of a drive mechanism in the original transport apparatus shown in FIG. 1;

FIG. 4 is a view of a drive mechanism in the original transport apparatus shown in FIG. 1;

FIG. 5 is an enlarged view of an original detection unit in the original transport apparatus shown in FIG. 1;

FIGS. 6(a)-6(c) are views showing a process of transporting an original in a single-side reading mode in the original transport apparatus shown in FIG. 1;

FIGS. 7(a) and 7(b) are views showing the process of transporting the original in the single-side reading mode continued from FIGS. 6(a)-6(c) in the original transport apparatus shown in FIG. 1;

FIGS. 8(a)-8(c) are views showing a process of transporting the original in a two-side reading mode at a high speed in the original transport apparatus according to the first embodiment of the present invention;

FIGS. 9(a) and 9(b) are views showing the process of transporting the original in the two-side reading mode at the high speed continued from FIGS. 8(a)-8(c) in the original transport apparatus according to the first embodiment of the present invention;

FIGS. 10(a)-10(c) are views showing the process of transporting the original in the two-side reading mode at the high speed continued from FIGS. 9(a) and 9(b) in the original transport apparatus according to the first embodiment of the present invention;

FIGS. 11(a)-11(c) are views showing the process of transporting the original in the two-side reading mode at the high speed continued from FIGS. 10(a)-10(c) in the original transport apparatus according to the first embodiment of the present invention;

FIGS. 12(a) and 12(b) are views showing the process of transporting the original in the two-sided reading mode at the high speed continued from FIGS. 11(a)-11(c) in the original transport apparatus according to the first embodiment of the present invention;

FIGS. 13(a)-13(c) are views showing a process of transporting the original in a two-sided reading mode with high precision in the original transport apparatus;

FIGS. 14(a) and 14(b) are views showing the process of transporting the original in the two-sided reading mode with high

precision continued from FIGS. 13(a)-13(c) in the original transport apparatus;

FIGS. 15(a)-15(b) are views showing the process of transporting the original in the two-sided reading mode with high precision continued from FIGS. 14(a) and 14(b) in the original transport apparatus;

FIG. 16 is a flow chart for transporting the original according to the present invention.

FIGS. 17(a)-17(c) are views showing a process of transporting the original in a two-side reading mode in an original transport apparatus according to the second embodiment of the present invention;

FIGS. 18(a)-18(c) are views showing the process of transporting the original in the two-side reading mode continued from FIGS. 17(a)-17(c) in the original transport apparatus according to the second embodiment of the present invention;

FIGS. 19(a)-19(c) are views showing a process of transporting the original in a two-side reading mode in an original transport apparatus according to the third embodiment of the present invention; and

FIGS. 20(a)-20(c) are views showing the process of transporting the original in the two-side reading mode continued from FIGS. 19(a)-19(c) in the original transport apparatus according to the third embodiment of the present invention.

Detailed Description of Preferred Embodiments

[0014] Hereunder, embodiments of the present invention will be described in detail with reference to the accompanying drawings. FIG. 1 is a vertical sectional view of an automatic document feeder according to an embodiment of he present invention. The

automatic document feeder is mounted on an image reading apparatus. FIG. 2 is a vertical sectional view of a main portion of the automatic document feeder.

[0001] As shown in FIG. 1, an automatic document feeder 10 (hereinafter referred to as ADF) is mounted on the image reading apparatus 1. The ADF 1 transports an original to pass over a top surface of the first platen 2 in the reading device 1. In the reading device 1, a light source 3 such as a lamp irradiates light on the original through the first platen 1. Mirrors 4 reflect the light, and reading means such as a charged couple device (CCD) reads an image on the original through photoelectric conversion.

[0002] The first platen 2 is a reading unit of the reading device 1, and the reading device 1 is provided with a second platen 5 having a surface area large enough for placing the original. In the reading device 1, when an operator opens the ADF 10 and places the original on the second platen 5, it is also possible to move a light source unit having the light source 3 and the mirrors 4 in a sub-scanning direction to read an image on the original through the second platen 5.

[0015] The ADF 1 is equipped with an original tray 15 for stacking a plurality of the originals; feeder unit (feeder means) 11 for feeding the original stacked on the original tray 9 one at a time to the first platen 2; a transfer unit (transfer means) 12 for passing the original over the first platen 2; a discharge unit (discharge means) 13 for receiving and discharging the original passing over the first platen 2; and a discharge tray 16 for storing the original discharged from the discharge unit 13. Additionally, the ADF 10 is equipped with a switchback unit 14 for switching back the original discharged from the first platen

2 at the discharge unit 13 and feeding the original to the feeder unit 11 and to the first platen 2 again; and a paper re-feed path 30. The original tray 15 is somewhat oblique to provide a space above the discharge tray 16.

[0016] A side guide 17 is provided for regulating a side of the original stacked on the original tray 15, and a stopper 60 is provided for regulating a leading edge of the original. The original tray 15 is mounted rotatably around a rotational point 15a at the leading edge of the original stacked on the original tray 15.

[0017] The feeder unit 11 is provided with a kick roller 18 moving vertically for touching the uppermost original stacked on the feeder unit 11 and for feeding the original; separating means having a feed roller 19 for feeding the originals fed by the kick roller 18 and a separating pad 20 for preventing the second sheet from being fed; and a pair of register rollers 21 for abutting against the leading edge of the original separated by the separation means to align the leading edge and for feeding the original further downstream along a paper feed path 25.

[0018] The transfer unit 12 is provided with a pair of transport rollers 22 at an upstream side of the first platen 2 for feeding the original to the first platen 2, and a pair of transport rollers 23 at a downstream side of the first platen 2 for discharging the original from the first platen 2. The original is transported through the transport path 26 formed between the first platen 2 and a lifter guide 6 in the main unit 1, and a backup guide 26a in the ADF 10.

[0019] The discharge unit 13 and the switchback unit 14 share a portion of the discharge tray 16, and are provided with a pair of discharge rollers 24 for discharging the original. The pair

of the discharge rollers 24 is controlled to rotate in reverse while nipping the trailing edge of the original in a two-side reading mode to switch back and send the original to the feeder unit 11 (described later).

[0020] The pair of the discharge rollers 24 is configured such that when the original is circulated from the switchback unit 14 via the discharge unit 13, the paper re-feed path 30 and the transport unit 12, the discharge rollers 24a (the first discharge roller) separates from the discharge rollers 24b (the second discharge roller). Accordingly, it is possible to transport the original without hindrance when the leading edge of the original crosses the trailing edge thereof.

[0021] A switchback path 28 and a flapper 29 for guiding the original to the discharge unit 13 are disposed at a shared portion of the discharge unit 13 and the switchback unit 14. The flapper 29 is constantly urged downwardly by an urging spring (not shown). When the original is transported to the pair of the discharge rollers 24 along the discharge path 27 through the discharge outlet 31 connected to the switchback path 28, the leading edge of the discharging original pushes the flapper upward to allow the original to pass therethrough. When the original is switched back by the pair of the discharge rollers 24, the flapper 29 is situated at a lower position to cover the discharge path for guiding the original into the switchback path 28.

[0022] The discharge path 27 is formed of an upper discharge guide 27a having a backup guide 26a facing the first platen 2, and a lower discharge guide 27b integrated with the discharge tray 16. The switchback path 28 is formed of an upper switchback guide 28a (see FIG. 2) connected to an original guide surface of

the flapper 29, and a lower discharge guide 27b extending from the discharge path 27 for guiding the original to the paper re-feed path 30. The paper re-feed path 30 extends from the switchback path 28, and guides the original to a feeding position (hereinafter referred to as a nipping position) of the pair of the register rollers 21 along with the upper switchback guide 28a and lower switchback guide 28b.

[0023] The paper re-feed path 30 and the paper feed path 25 join at the nipping point of the pair of the register rollers 21. A Mylar sheet 28c is provided at the jointing point for guiding the original to the nipping point of the pair of the register rollers 21.

[0024] A drive mechanism of each roller will be explained with reference to FIG. 3 and FIG. 4. In the ADF 10, a paper feed motor M1 and a transport motor M2 capable of rotating both forward and in reverse are provided for driving each of the rollers. FIG. 3 shows the drive transmission system of the paper feed motor M1, and FIG. 4 shows the drive transmission system of the transport motor M2.

[0025] As shown in FIG. 3, in the drive transmission system of the paper feed motor M1, the forward rotational drive of the paper feed motor M1 is transmitted from a pulley P16 to a pulley P36 via a timing belt T16. The drive of the pulley P36 is transmitted to a gear Z17, a gear Z19, and a gear Z18 mounted on a drive shaft of the paper feed roller 19 in this order, so that the paper feed roller 19 rotates in the paper feed direction. A pulley P18 is disposed on the drive shaft of the paper feed roller 19 for transmitting the drive to the kick roller 18 via the timing belt T2 trained between a pulley P11 disposed on a

shaft of the kick roller 18 and a shaft of the paper feed roller 19.

[0026] An end of the elevator arm 18a supporting the kick roller 18 is mounted on the drive shaft of the paper feed roller 19. The drive shaft rotates forward in the paper feed direction (forward rotation of the paper feed motor M1) to rotate the elevator arm 18a, so that the kick roller 18 is lowered to contact the original. The drive shaft of the paper feed roller 19 rotates idle with regard to the elevator arm 18a through a spring clutch A and a spring clutch B. Although the register roller 21a is connected with the timing belt T3 trained between a pulley P28 disposed on a drive shaft of the register roller 21a and a pulley P22 coaxially disposed on a shaft of a pulley P36, the register roller 21a does not rotate because of the one-way clutch OW1 disposed in the pulley P28.

[0027] The reverse drive of the paper feed motor M1 is transmitted from the pulley P16 to the pulley P36 via the timing belt T16, and is transmitted from the pulley 22 coaxially disposed on the shaft of the pulley P36 via the timing belt T3 to the pulley P28 mounted on the shaft of the register roller 21a to rotate the register roller 21a in the paper feed direction.

[0028] The reverse rotational drive of the paper feed motor M1 is also transmitted to the drive shaft of the paper feed roller 19, and the elevator arm 18a rotates in the counterclockwise direction to raise the kick roller 18. The paper feed roller 19 does not rotate because of the one-way clutch OW2 disposed therein. The raised elevator arm 18a touches a regulating member (not shown), and the drive shaft of the paper feed roller 19 rotates idle with regard to the elevator arm 18a due to the spring clutch C.

[0029] As shown in FIG. 4, the drive transmission system of the transport motor M2 transmits the drive from the pulley P26 disposed on a drive shaft of the transport motor M2 to a pulley P46 via a timing belt T4. The drive is then transmitted from a pulley P33 coaxially disposed on a shaft of the pulley P46 to a pulley P32 mounted on the transport rollers 23a via a timing belt T6 to rotate the transport rollers 22a forward or in reverse.

[0030] The drive transmitted to the pulley P32 is then transmitted to a gear Z2 via a gear Z1 coaxially mounted on a shaft of the pulley P32 to rotate the transport rollers 23b via the spring clutch C. The transport rollers 23a and transport rollers 23b rotate at a same peripheral speed. When the transport rollers 23a and transport rollers 23b rotate at different peripheral speeds, the spring clutch C absorbs the difference in the peripheral speeds.

[0031] The drive transmitted to the pulley P32 is transmitted via a timing belt T7 to a pulley P31 mounted on the shaft of the transport rollers 22a to rotate the transport rollers 22a forward or in reverse. The drive transmitted to the pulley P31 is transmitted to a gear Z4 via a gear Z3 coaxially mounted on the shaft of the pulley P31 to rotate the transport rollers 22b via the spring clutch D. The transport rollers 22a and transport rollers 22b rotate at a same peripheral speed. When the transport rollers 22a and transport rollers 22b rotate at different peripheral speeds, the spring clutch D absorbs the difference in the peripheral speeds.

[0032] The drive of the transport motor M2 transmitted to the pulley P46 via the timing belt T4 is transmitted from a pulley P42 coaxially mounted on a shaft of the pulley P46 to the pulley P48 via the timing belt T5. As a result, the discharge rollers

24a (the first discharge roller) mounted to the shaft of the discharge rollers 24a via the spring clutch E rotate forward or in reverse.

[0033] The drive transmitted to the pulley P48 is transmitted to a gear Z6 via a gear Z5 coaxially mounted on a shaft of the pulley P48 to rotate the discharge rollers 24b. The transport rollers 23a and discharge rollers 24b rotate at a same peripheral speed. The discharge rollers 24a rotate at a peripheral speed faster than that of the discharge rollers 24b. When the discharge rollers 24a and the discharge rollers 24b nip a single sheet or no sheet, the discharge rollers 24a and the discharge rollers 24b rotate at a same peripheral speed through the spring clutch E.

[0034] A pressing solenoid SOL is provided as a drive source to separate the pair of the discharge rollers 24. When the pressing solenoid SOL is excited (ON), the pressing solenoid SOL moves and presses the discharge rollers 24b against the discharge rollers 24a. When the pressing solenoid SOL is not excited (OFF), an urging spring urges and moves the discharge rollers 24b away from the discharge rollers 24a.

[0035] A return prevention lever 35 is disposed on the discharge rollers 24a via a spring clutch F. When the discharge rollers 24a rotate in the discharge direction (counterclockwise direction), the return prevention lever 35 stops at an upper position retracted away from the discharge outlet. When the discharge rollers 24a rotate in the switchback direction (clockwise direction), the return prevention lever 35 is lowered to the paper discharge outlet. The return prevention lever 35 slips and stops near the upper surface of the sheet due to the

spring clutch F, thereby preventing the discharged sheet from returning into the mechanism.

[0036] A plurality of sensors S1, S2 and S3 (see FIG. 1) is arranged on the original tray 15 in the original feeding direction to detect a length of the original placed on the original tray 15 through on and off states of the sensors. A width of the original stacked on the original tray 15 is determined through a volume (not shown) according to an amount of movement of the side guide 17. Accordingly, it is possible to determine a size of the original based on the detected width and the detected length of the original.

[0037] As shown in FIGS. 6(a)-6(c) and 7(a)-7(b), in a path for guiding the original, there are arranged an empty sensor S4 for detecting the original stacked on the original tray 15; a register sensor S5 for detecting the leading edge of the original fed to the paper feed path 25; a read sensor S6 disposed in front of the first platen 2 for detecting the leading edge of the original; and a discharge sensor S7 for detecting the trailing edge of the original discharged from the first platen 2.

[0038] The read sensor S6 is a lever type sensor, as shown in FIG. 5, and is arranged in a curved portion of the paper feed path 25. A protrusion 25c formed of a plurality of ribs is disposed at an original detection position of the lower paper feed guide 25b of the read sensor S6. A sensor lever S6a on the read sensor S6 extends to the paper feed path 25 where the protrusion 25C is disposed. The protrusion 25C corrects and guides the leading edge of the original to a narrow gap between the protrusion 25C and the upper paper guide 25a, so that the leading edge of the original is detected at a same timing.

[0039] Each of the sensors is connected to the CPU that controls the drive of the entire apparatus. Based on the detection signals from each of the sensors, the motors M1 and M2 described above are driven and the pressing solenoid SOL is excited.

[0040] An operation of transporting the original in the ADF 10 of the first embodiment will be described in detail next with reference to FIGS. 6(a)-6(c) to FIGS. 12(a)-12(b) as necessary. A number in a triangle attached to an original D1 or an original D2 shown in the drawings represents a page number of the original.

[0041] In the single-side reading mode for reading one side of the original, when the original is on the original tray 15 and the empty sensor turns on, the paper feed motor M1 starts rotating forward to feed the first original D1. At this time, the kick roller 18 and the paper feed roller 19 rotate in the paper feed direction, and the pair of the register rollers 21 do not rotate due to the one-way clutch OW1.

[0042] When the register sensor S5 detects the leading edge of the original, the paper feed motor M1 transports the original for a predetermined amount of time and stops. When the paper feed motor M1 stops, the leading edge of the original abuts against the nipping position on the pair of the register rollers 21 to form a bend portion, thereby aligning the leading edge of the original and removing skew (see FIG. 6(a)).

[0043] Then, the paper feed motor M1 rotates in reverse. At the same time, the transport motor M2 rotates, and the pressing solenoid SOL is excited. At this time, the kick roller 18 rises to the position away from the original. The one-way clutch OW1 cuts the drive of the paper feed roller 19, and the register

roller 21a of the pair of register rollers 21 rotates in the paper feed direction.

[0044] The motors M1 and M2 rotate to transport the original D1 from the paper feed path 25 to the transport path 26. After the read sensor S6 detects the leading edge of the original, the paper feed motor M1 stops after a predetermined amount of time, and the transport motor M2 temporarily stops (see FIG. 6(b)).

[0045] When a read transport signal is received from a main unit of the image reading apparatus 1, the transport motor M2 is driven again. The reading means scans and reads one side of the original D1. At this time, the original D1 is transported to the discharge tray 16 while the leading edge thereof lifts a leading edge of the flapper 29 arranged to cover the discharge path 27.

[0046] After the original D1 is transported and the register sensor S5 detects the trailing edge of the original D1 passing, it is determined whether there is the second original on the original tray 15. If there is the second original, the ADF starts feeding the second original D2 in the same way as for the first original D1.

[0047] In the same way for the first original, the paper feed motor M1 rotates forward to rotate the kick roller 18 and the paper feed roller 19, so that the leading edge of the original D2 abuts against the nipping point of the pair of the register rollers 21 to remove skew in the original D2 (see FIG. 6(c)). The paper feed motor M1 then rotates in reverse and stops after a predetermined amount of time after the read sensor S6 detects the leading edge of the second original, and the transport motor M2 also stops. Accordingly, the original D2 stops with the leading edge positioned in front of the first platen 2. The first

original D1 stops with the trailing edge being nipped by the pair of the discharge rollers 24. (See FIG. 7(a))

[0048] When the read transport signal is received from the main unit of the image reading apparatus 1, the transport motor M2 is driven again, and the reading means scans and reads the front side of the original D2. The first original D1 is discharged to the discharge tray 16 while reading the second original D2 (see FIG. 7(b)).

[0049] When the register sensor S5 detects the trailing edge of the original D2, the empty sensor S4 determines whether another original exists. If there is still another original, the system starts the paper feed operation for the third original in the same way for the second original D2. As long as the empty sensor D4 detects the original, the same processing will be performed for the subsequent original.

[0050] After the discharge sensor S7 detects the trailing edge of the last original, the transport motor M2 stops after an amount of time required for discharging the last original to the discharge tray 16. The pressing solenoid SOL is turned off to complete the processing of all the originals.

[0051] The two-side reading mode will be explained next. In the two-side reading mode, an operator selects the mode at a high speed or with high precision using a selection switch (not shown). The two-side reading mode at a high speed will be described below.

[0052] In reading both sides of the first original, when the empty sensor S4 detects the first original on the original tray 15, the paper feed motor M1 rotates forward to rotate the kick roller 18 and the paper feed roller 19, so that the leading edge of the original abuts against the nipping point of the pair of the register rollers 21 to remove skew.

[0053] The paper feed motor M1 and the transport motor M2 stop after the read sensor S6 detects the leading edge of the original transported by the reverse drive of the paper feed motor M1 and the forward drive of the transport motor M2. The original D1 stops with the leading edge thereof in front of the first platen 2. The pressing solenoid SOL is excited and presses the pair of the discharge rollers 24 (see FIG. 8(a)).

[0054] The transport motor M2 drives in the forward direction when the read signal is received from the main unit of the image reading apparatus 1. The reading means scans the front surface of the original on the first platen 2 to read. Then, the original D1 read at the first platen 2 is guided into the discharge path 27.

[0055] The original D1 is guided from the discharge path 27 to the discharge outlet 31, and transported to the discharge tray 16 with the leading edge thereof lifting the leading edge of the flapper 29 covering the discharge path 31. The transport motor M2 stops after an amount of time required for the trailing edge of the original D1 to pass the flapper 29 after the discharge sensor S7 detects the trailing edge thereof passing through. The original D1 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (FIG. 8(b)).

[0056] Then, the transport motor M2 rotates in reverse, so that the discharge rollers 24a rotates in reverse and the original D1 is switched back. The original D1 is guided from the switchback path 28 to the re-feed path 30 along the original guide surface of the flapper 29 situated at a position for covering the discharge outlet 31 when the original passes. After the register sensor S5 detects the leading edge of the original D1 guided into the re-feed path 30, and the original D1 abuts

against the nipping point of the pair of the register rollers 21 to a bend to remove skew, the transport motor M2 driven in the reverse direction stops after a predetermined amount of time (see FIG. 8(c)).

[0057] The paper feed motor M1 is also driven in reverse to feed the original D1. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing solenoid SOL is stopped after an amount of time, so that the pair of the register rollers 21 securely nips the leading edge of the original D1. The discharge follower rollers 24b move downwardly away from the discharge rollers 24a, and the transport motor M2 is driven in the forward direction.

[0058] The original D1 is turned over and then fed along the paper feed path 25. When the read sensor S6 detects the leading edge of the original, the paper feed motor M1 stops and the transport motor M2 stops after a predetermined amount of time. Upon receiving the read transport signal from the main unit of the image reading apparatus 1, the transport motor M2 is driven again to move the reading means in the sub-scan direction to read the other side of the original D1. At this time, the leading edge of the original D1 moving to the discharge tray 16 and the trailing edge of the original D1 being fed pass each other in the portion shared by the discharge path 27 including the pair of the discharge rollers 24 and the switchback path 28. The pair of the discharge rollers 24 is separated, the original D1 is transported with no hindrance (see FIG. 9(a)).

[0059] When the register sensor S5 detects the trailing edge of the original D1, the pressing solenoid SOL is excited to separate the pair of the discharge rollers 24, and the transport

motor M2 stops after a predetermined amount of time after the discharge sensor S7 detects the trailing edge of the original D1. The original D1 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (see FIG. 9(b)).

[0060] Next, when the register sensor S5 detects the trailing edge of the original D1 passing, the empty sensor S4 determines whether another original exists. If there is, the system starts the paper feed operation for the second original D2.

[0061] In the same way as for the first original D1, the paper feed motor M1 is driven in the forward direction to rotate the kick roller 18 and the paper feed roller 19 to abut the second original D2 against the nipping position of the pair of the register rollers 21 to remove any skew. The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transports the original D2 so that the leading edge thereof is separated only by a predetermined distance from the pair of the register rollers 21 (distance Z shown in FIG. 10(b)). Then, the motors stop (see FIG. 11(a)).

[0062] Then, the original D1 is turned over 180 degrees, and sent without processing to organize the page order before being discharged to the discharge tray 16. For that purpose, the transport motor M2 is driven in reverse to abut the leading edge of the original D1 against the nipping point (the paper feed position) of the pair of the register rollers 21 in the re-feed path 30 to remove any skew. A shift between the leading edges of the original D2 and the original D1 is the distance Z shown in FIG. 10(b).

[0063] The original D2 and the original D1 are fed with the reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 while the two

sheets are overlapped. The drive of the paper feed motor M1 stops when the read sensor S6 detects the leading edge of the original D2. The paper feed motor M1 and the transport motor M2 stop temporarily after the read sensor S6 detects the leading edge of the original D2 with the leading edge thereof in front of the first platen 2. At this time, the pressing solenoid SOL is excited and presses the pair of the discharge rollers 24 (see FIG. 10(c)). When the read signal is received from the main unit of the image reading apparatus 1, the transport motor M2 drives forward to move the reading means in the sub-scan direction to read the front surface of the original D2 sent to the first platen 2.

[0064] At this point, the image data of the front surface of the original D1 (for example, data of an inverted image on the front side of the original D1) is stored in a read data storage unit for determining a type of the surface. The image data is shifted by an amount equivalent to the discrepancy amount Z, and is compared to the image data of the original D2. If it is determined that the inverted image on the front surface of the original D1 fed without processing is seen through to the other side, a warning signal is sent, so that the operator can cancel, abort, or correct the image data. The operator may cancel the transport of the two originals in the overlapped state, and send the original through the system without processing to re-order as in the conventional technology, thereby prevent the inverted image from being seen through.

[0065] The original D1 is transported while overlapping with the original D2 read at the first platen 2, and is guided to the discharge path 27. The original D1 is transported to the discharge tray 16 with the leading edge of the original D2

lifting the leading edge of the flapper 29 arranged to cover the discharge path 31. In this state, when the trailing edge of the original D1 passing through the pair of the transport rollers 23 is detected, the original D1 is transported at the peripheral speed of the discharge rollers 24a (first discharge roller) and the original D2 is transported at the peripheral speed of the discharge rollers 24b (second discharge roller) (see FIG. 11(d)).

[0066] It is possible to set the transport speeds of the originals D1 and D2 to satisfy the following formula.

$$V1 = V2\ (L + H)/(L - Z)$$

where V1 is the peripheral speed of the discharge rollers 24a; V2 is the peripheral speed of the discharge rollers 24b; Z is the shift between the original D1 and the original D2; L is a distance between the transport rollers 23 and a pass through point of the flapper 29 (position where the switchback is possible); and H is a distance between the pass through position of the flapper 29 and the return prevention lever 35. When the transport speeds of the originals D1 and D2 are set in this way, the trailing edge of the original D1 reaches the return prevention lever 35 when the trailing edge of the original reaches the switchback position.

[0067] After the discharge sensor S7 detects the trailing edge of the original D1, the transport motor M2 stops after the amount of time required for the trailing edge to pass the return prevention lever 35 disposed at a downstream side of the flapper 29. The original D2 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (see FIG. 11(a)).

[0068] Then, the transport motor M2 rotates in reverse to rotate the discharge rollers 24a and 24b in reverse to stop the original D1 at the return prevention lever 35, and only the

original D2 is switched back. The original D2 is guided to the switchback path 28 along the original guide surface of the flapper 29 moving to a position for covering the discharge outlet 31 when the original D2 passes through (see FIG. 12(a)).

[0069] After the register sensor S5 detects the leading edge of the original D2 guided from the switchback path 28 into the re-feed path 30, and the original D2 abuts against the nipping point of the pair of the register rollers 21 to form a bend to remove any skew, the transport motor M2 driven in the reverse direction stops after a predetermined amount of time.

[0070] The paper feed motor M1 is also driven in reverse to re-feed the original D2. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing solenoid SOL is stopped after an amount of time that the pair of the register rollers 21 securely nips the leading edge of the original D1. The discharge rollers 24b move downwardly away from the discharge rollers 24a, and the transport motor M2 is driven in the forward direction. When the trailing edge of the original D2 passes the return prevention lever 35, the trailing edge of the original D1 stopped by the lever falls into the discharge tray 16 to complete the process (see FIG. 12(b)). The backside of the original D2 transported to the transport path 26 is then read.

[0071] When the register sensor S5 detects the trailing edge of the original D2 passing, the empty sensor S4 determines whether another original exists. If there is still another original, the system begins the paper feed operation for the third original in the same way for the second original D2. The operations shown in FIGS. 10(a)-10(c) to FIGS. 12(b)-12(c) are repeated to read the third original D3. As long as the empty

sensor D4 detects the originals, the same processing will be performed for subsequent original D4, original D5 and beyond.

[0072] Except for the last original, the originals are transported through the system without processing and read in the same way as described to re-order the pages of the originals. Accordingly, it is possible to improve the productivity for reading both sides of the originals. After the discharge sensor S7 detects the trailing edge of the last original, the transport motor M2 stops after the amount of time required for discharging the last original to the discharge tray 16. The excitation of the pressing solenoid SOL is stopped to complete the processing of all the originals.

[0073] An operation of both sides of the first original with high precision will be explained next. When the empty sensor S4 detects the original on the original tray 15, the paper feed motor M1 rotates in the forward direction to rotate the kick roller 18 and the paper feed roller 19 in the same way as when reading one side of the first original D1. Accordingly, the leading edge of the original abuts against the nipping point of the pair of the register rollers 21 to remove any skew.

[0074] The paper feed motor M1 and the transport motor M2 stop after the read sensor S6 detects the leading edge of the original transported by the reverse drive of the paper feed motor M1 and the forward drive of the transport motor M2. The original D1 stops with the leading edge thereof being in front of the first platen 2. At this time, the pressing solenoid SOL is excited and presses the pair of the discharge rollers 24 (see FIG. 13(a)).

[0075] The transport motor M2 drives in the forward direction when the read signal is received from the main unit of the image reading apparatus 1. The reading means scans and reads the front

surface of the original being sent to the first platen 2. Then, the original D1 on the first platen 2 is guided into the discharge path 27.

[0076] The original D1 is guided from the discharge path 27 to the discharge outlet 31, and is transported to the discharge tray 16 while the leading edge thereof lifts the leading edge of the flapper 29 arranged to cover the discharge path 31. After discharge sensor S7 detects the trailing edge of the original, the transport motor M2 stops after the amount of time required for the trailing edge of the original D1 to pass the flapper 29. The original D1 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (FIG. 13(b)).

[0077] The transport motor M2 rotates in reverse to rotate the discharge rollers 24a in reverse to switchback the original D1, so that the original is guided from the switchback path 28 to the re-feed path 30 along the original guide surface of the flapper 29 moving to a position that covers the discharge outlet 31 when the original passes through. After the register sensor S5 detects the leading edge of the original D1 guided into the re-feed path 30 and the original D1 abuts against the nipping point on the pair of the register rollers 21 to form a bend to remove any skew, the transport motor M2 driven in the reverse direction stops after a predetermined amount of time (see FIG. 13(c)).

[0078] The paper feed motor M1 is also driven in reverse to re-feed the original D1. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing solenoid SOL is stopped after an amount of time that the pair of the register rollers 21 securely nips the leading edge of the original D1. The discharge follower rollers 24b move downwardly away from the

discharge rollers 24a, and the transport motor M2 is driven in the forward direction.

[0079] The original D1 is turned over and then fed along the paper feed path 25. When the read sensor S6 detects the leading edge of the original, the paper feed motor M1 stops and the transport motor M2 stops after a predetermined amount of time. Upon receiving the read transport signal from the main unit of the image reading apparatus 1, the transport motor M2 is driven again to move the reading means in the sub-scan direction for reading the other side of the original D1. At this time, the leading edge of the original D1 transported to the discharge tray 16 and the trailing edge of the original D1 pass each other in the area shared by the discharge path 27 including the pair of discharge rollers 24 and the switchback path 28. The pair of the discharge rollers 24 is separated, so that the original D1 is transported with no hindrance (see FIG. 14(a)).

[0080] When the register sensor S5 detects the trailing edge of the original D1, the pair of the discharge rollers 24 is separated by the excitation of the pressing solenoid SOL, and the transport motor M2 stops after a predetermined amount of time after the discharge sensor S7 detects the trailing edge of the original D1. The original D1 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (see FIG. 14(b)).

[0081] Then, the original D1 is turned over 180 degrees, and sent without processing to organize the page order before being discharged to the discharge tray 16. The paper feed motor M1 is also driven in reverse to re-feed the original D1. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing

solenoid SOL is stopped after an amount of time that the pair of the register rollers 21 securely nips the leading edge of the original D1. The discharge follower rollers 24b move downwardly away from the discharge rollers 24a, and the transport motor M2 is driven in the forward direction.

[0082] The original D1 is transported along the paper feed path 25, turned over and transported to the discharge path 27. At this time, the leading edge of the original D1 sent to the discharge tray 16 and the trailing edge of the original D1 pass each other in the portion shared by the discharge path 27 including the pair of discharge rollers 24 and the switchback path 28. The pair of the discharge rollers 24 is separated, so that the original D1 is transported with no hindrance (see FIG. 14(a)).

[0083] The original D1 is guided from the discharge path 27 to the discharge outlet 31, and is transported to the discharge tray 16 with the leading edge lifting the leading edge of the flapper 29 arranged to cover the discharge path 31. In this state, when the trailing edge of the original D1 passes through the pair of the transport rollers 23, the original D1 is transported at the peripheral speed of the discharge rollers 24a (first discharge roller) (see FIG. 15(a)).

[0084] When the register sensor S5 detects the trailing edge of the original D1 passing, the empty sensor S4 determines whether another original exists. If there is, the system starts the paper feed operation for the second original D2 (see FIG. 15(b)). The trailing edge of the original D1 falls into the discharge tray 16 to complete the process (see FIG. 15(b)).

[0085] In the same way as for the first original D1, the paper feed motor M1 is driven in the forward direction to rotate the

kick roller 18 and the paper feed roller 19, so that the second original D2 abuts against the nipping position of the pair of the register rollers 21 to remove any skew. The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transport the original D2, and the leading edge thereof is nipped by the pair of the register rollers 21. Then, the drives stop (see FIG. 13(a)).

[0086] In the same operations used for processing the first original D1, the second original D2 is read. Then, the original D2 is turned over 180 degrees, and sent without processing to organize the page order before being discharged to the discharge tray 16.

[0087] When the register sensor S5 detects that the trailing edge of the original D2 passes, the empty sensor S4 determines whether another original exists. If there is still another original, the system starts the paper feed operation for the third original in the same way as for the second original D2. The operations shown in FIGS. 13(a)-13(c) to FIGS. 15(a)-15(c) are repeated to read the third original D3.

[0088] As long as the empty sensor D4 detects the originals, the same processing will be performed for the subsequent originals D4, D5 and beyond. In this way, the originals are transported one at a time and read in the high precision reading mode. Accordingly, it is possible to prevent the image on the surface of the overlapped original from seeing through the original to be read when the two originals are overlapped in the high speed reading mode, thereby obtaining precise and clear images.

[0089] After the discharge sensor S7 detects the trailing edge of the last original, the transport motor M2 stops after the

amount of time required for discharging the last original to the discharge tray 16. The excitation of the pressing solenoid SOL is stopped to complete the processing of all the originals.

[0090] FIG. 16 is a flow chart for transporting the original in a high speed reading mode. A process of transporting the original to read both sides thereof will be described with reference to FIG. 16.

[0091] The first original stacked on the original tray is fed to a predetermined feeding position (ST1). The original fed to the feeding position is then transported to the reading position (ST2). One side of the original transported to the predetermined reading position is read (ST3). The original is switched back and turned over (ST4). The original switched back and turned over is then fed to the feeding position again (ST5). Then, the other side of the original is read (ST6). After the both sides of the original are read, the original is switched back and turned over again (ST7).

[0092] When the reading of both sides is completed, the original is sent to the feeding position again (ST8). The original is transported via the reading position while overlapping the next original to be fed (second original) (ST9). Then, one side of the next original is read (ST10).

[0093] After the both sides of the first original are read, the first original is transported in a state that the leading edge thereof is shifted by a predetermined distance from the leading edge of the second original at the feeding position. After the one side of the next original is read, the next original is switched back and sent to the feeding position (ST11). The first original with the both sides read is discharged (ST12).

[0094] The next original (second original) with the one side read is transported, and the other side thereof is read (ST13). If there are more originals to be processed, the steps from ST7 to ST11 are repeated (ST14). If there are no more original, the last original is switched back, turned over and passed through the system with no processing before being discharged (ST15).

[0095] Another embodiment of the instant invention will be described in detail. FIGS. 17(a)-17(c) and FIGS. 18(a)-18(c) are sectional views of an ADF 10 according to the second embodiment. A control operation of transporting the original in the ADF 10 of the second embodiment will be described with reference to FIGS. 17(a)-17(c) and FIGS. 18(a)-18(c). The first original is read in the same way as the first embodiment, and the description thereof is omitted.

[0096] According to the second embodiment, the original D1 is transported to the discharge path 27 for reading, and is transported from the switchback path 28 to the re-feed path 30 by the reverse rotational drive of the transport motor M2. The leading edge of the original D1 abuts against the pair of the register rollers 21 to eliminate any skew (see FIG. 17(a)). The leading edge is transported for a certain distance (distance Z shown in FIG. 17(b)) from the pair of the register rollers 21, and the original is temporarily stopped.

[0097] In the same way as for the first original D1, the paper feed motor M1 is driven in the forward direction to rotate the kick roller 18 and the paper feed roller 19, so that the second original D2 abuts against the nipping point of the pair of the register rollers 21 to remove any skew. The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transport the original D2 to the

reading position. In this case, the first original D1 is transported before the second original D2, and the first original D1 is shifted from the second original D2 in a direction opposite to that in the first embodiment (shift amount Z, see FIG. 17(b)).

[0098] The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transport the original D2 and the original D1 while the two originals are overlapped. When the read sensor S6 detects the leading edge of the original D1, the paper feed motor M1 stops. The paper feed motor M1 and the transport motor M2 stop temporarily after the read sensor S6 detects the leading edge of the original D2 while the leading edge of the original D1 is stopped in front of the first platen 2. At this time, the pressing solenoid SOL is excited and presses the pair of the discharge rollers 24.

[0099] The shift amount from the leading edge of the original D1 is measured in a pulse count to determine the reading starting position, and the reading starts. When the read signal is received from the main unit of the image reading apparatus 1, the transport motor M2 drives in the forward direction to transport the original D2 to the first platen 2, and the reading means moves in the sub-scan direction to read the front surface thereof (see FIG. 17(c)).

[00100] While the original D2 is read at the first platen 2, the original D1 is guided to the discharge path 27. The discharge rollers 24a and discharge rollers 24b rotate at a same peripheral speed. While the original D2 is guided from the discharge path 27 to the discharge outlet 31, the original D1 is transported to the discharge tray 16 with the leading edge

lifting the leading edge of the flapper 29 arranged to cover the discharge path 31.

[00101] After the discharge sensor S7 detects the trailing edge of the original D1, when the trailing edge thereof is detected to pass the position of the return prevention lever 35 disposed at a downstream side of the flapper 29, the transport motor M2 stops, and the pair of the discharge rollers 24 nips the trailing edge of the original D2 (see FIG. 18(a)).

[00102] Then, the transport motor M2 rotates in reverse to rotate the discharge rollers 24a and 24b in reverse to stop the original D1 at the return prevention lever 35, and only the original D2 is switched back. The original D2 is guided to the switchback path 28 along the original guide surface of the flapper 29 moving to a position for covering the discharge outlet 31 when the original D2 passes (see FIG. 18(b)).

[00103] After the register sensor S5 detects the leading edge of the original D2 guided from the switchback path 28 into the re-feed path 30, the original D2 abuts against the nipping point of the register rollers 21 to form a bend to remove any skew, and the transport motor M2 driven in the reverse direction stops after a predetermined amount of time.

[00104] The paper feed motor M1 is also driven in reverse to re-feed the original D2. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing solenoid SOL is stopped after an amount of time that the pair of the register rollers 21 securely nips the leading edge of the original D2. The discharge rollers 24b moves downwardly away from the discharge rollers 24a, and the transport motor M2 is driven in the forward direction. When the trailing edge of the original D2

passes the return prevention lever 35, the trailing edge of the original D1 stopped by the lever falls into the discharge tray 16 to complete the process (see FIG. 18(c)). Then, the original D2 is transported to the transport path 26. The backside of the original D2 is read in the same processes as those used for reading the front side.

[00105] In the second embodiment of the present invention, the trailing edge of the original D1 moves ahead of the trailing edge of the original D2. Accordingly, it is possible to discharge the original D1 without rotating the discharge rollers 24a and discharge rollers 24b at different speeds.

[00106] FIGS. 19(a)-19(c) and FIGS. 20(a)-20(c) are sectional views of an ADF 10 according to the third embodiment of the present invention. A control operation of transporting the original in the ADF 10 of the third embodiment will be described with reference to FIGS. 19(a)-19(c) and FIGS. 20(a)-20(c). The first original is read in the same way as the first embodiment, and the description thereof is omitted.

[00107] According to the third embodiment of the present invention, the register rollers 21a and 21b, the transport rollers 22a and 22b, the transport rollers 23a and 23b and the discharge rollers 24a and 24b rotate at different speeds. The speeds are set in the following way: the register rollers 21a > 21b; the transport rollers 22a > 22b; and the transport rollers 23a > 23b. A torque limiter is disposed in the discharge rollers 24a.

[00108] In the third embodiment, in the same way as for the first original D1, the paper feed motor M1 is driven in the forward direction to rotate the kick roller 18 and the paper feed roller 19, so that the second original D2 abuts against the

nipping point of the pair of the register rollers 21 to remove any skew. The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transport the original D2, and the leading edge thereof is transported by a certain distance from the pair of the register rollers 21 (distance Z in FIG. 19(a)) before the drives are stopped.

[00109] The original D1 is transported from the switchback path 28 to the re-feed path 30 by the reverse rotational drive of the transport motor M2. The leading edge of the original D1 abuts against the nipping point of the pair of the register rollers 21 to eliminate any skew (see FIG. 19(a)). When only the original that is read is transported (when transporting one original), the discharge rollers 24b is driven at the speed of the discharge rollers 24a due to the torque limiter.

[00110] The reverse rotational drive of the paper feed motor M1 and the forward rotational drive of the transport motor M2 transport the original D2 and the original D1 while the two original are overlapped. The paper feed motor M1 stops when the read sensor S6 detects the leading edge of the original D2. After the read sensor S6 detects the leading edge of the original D2, the paper feed motor M1 and the transport motor M2 stop temporarily, and the leading edge of the original D2 is stopped in front of the first platen 2. At this time, the pressing solenoid SOL is excited and presses the pair of the discharge rollers 24.

[00111] Each of the pair rollers rotates according to the relationship, i.e. the register rollers 21a > 21b and the transport rollers 22a > 22b. Accordingly, when the originals D1 and D2 are transported to the reading position, the leading edges

of the originals D1 and D2 are aligned (see FIG. 19(b)). When the read signal is received from the main unit of the image reading apparatus 1, the transport motor M2 drives in the forward direction to transport the original D2 to the first platen 2, and the reading means scans to read the front surface thereof.

[00112] While the original D2 is read at the first platen 2, the original D1 is guided to the discharge path 27 (see FIG. 19(c)). While the original D2 is guided to the discharge path 27, the leading edge of the original D1 is ahead of the original D2, and the leading edge of the original D1 is transported to the discharge tray 16 with the leading edge lifting the leading edge of the flapper 29 arranged to cover the discharge path 31.

[00113] After the discharge sensor S7 detects the trailing edge of the original D1 and the trailing edge passes the position of the return prevention lever 35 disposed at a downstream side of the flapper 29, the transport motor M2 stops. The original D2 stops with the trailing edge thereof nipped by the pair of the discharge rollers 24 (see FIG. 20(a)).

[00114] Then, the transport motor M2 rotates in reverse to rotate the discharge rollers 24a and 24b in reverse, so that the original D1 is stopped at the return prevention lever 35, and only the original D2 is switched back. The original D2 is guided to the switchback path 28 along the original guide surface of the flapper 29 moving to a position that covers the discharge outlet 31 when the original D2 passes (see FIG. 20(b))

[00115] After the register sensor S5 detects the leading edge of the original D2 guided from the switchback path 28 into the re-feed path 30, the original D2 abuts against the nipping point on the pair of the register rollers 21 to form a bend to remove any skew, and the transport motor M2 driven in the reverse

direction stops after a predetermined amount of time. The paper feed motor M1 is also driven in reverse to re-feed the original D2. The reverse drive of the paper feed motor M1 rotates the register roller 21a in the paper feed direction. The excitation of the pressing solenoid SOL is stopped after an amount of time that the pair of register rollers 21 securely nips the leading edge of the original D2. The discharge rollers 24b moves downwardly away from the discharge rollers 24a, and the transport motor M2 is driven in the forward direction. When the trailing edge of the original D2 passes the return prevention lever 35, the trailing edge of the original D1 stopped by the lever falls into the discharge tray 16 to complete the process (see FIG. 20(c)). The original D2 is transported to the first platen for reading the backside thereof, and is then transported to the discharge path 27.

[00116] As described above, in the third embodiment, it is possible to move the trailing edge of the original D1 ahead of the trailing edge of the original D2 for a long distance from the position where the leading edge of the original D2 passes the read sensor S6 to the switchback point. Note that the shift is set such that the original D2 moves ahead of the original D1 from a point for registering the first original D1 to the read sensor.

[00117] As described above, according to the present invention, the original transport apparatus includes the original tray for stacking the original; the feed means for feeding the original one at a time to a predetermined feeding position; the transport means for transporting the original from the feeding position to the discharge outlet via the reading position; the switchback path disposed adjacent to the discharge outlet in the discharge direction for switching back and turning over the original; the

re-feed path for guiding the original to the feeding position after the original is switched back and turned over in the switchback path; and the discharge means disposed at a downstream side of the switchback path for discharging the original to the discharge tray after the original is read.

[00118] In the original transport apparatus and original transport method of the present invention, after both sides of the original are read, the original is fed to the feeding position via the switchback path. The feed means transports the original via the reading position while overlapping the next original to be read, and the discharge means discharges the first original via the discharge outlet.

[00119] In the invention, after reading the original, the original is overlapped with the next original and is fed to organize the page order. Accordingly, it is possible to transport the original and the next original at the same time. As a result, it is possible to read the both sides of the original and obtain the initial page order. In the conventional apparatus, it is necessary to transport the original three times through the reading position for reading the both sides of the original. In the invention, it is possible to complete the reading by transporting the original twice, thereby reading both sides of the original at a high speed.

[00120] While the invention has been explained with reference to the specific embodiments of the invention, the explanation is illustrative and the invention is limited only by the appended claims.